

## PATENT COOPERATION TREATY

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## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

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in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 18 May 2000 (18.05.00)	
<b>International application No.</b> PCT/GB99/03322	<b>Applicant's or agent's file reference</b> WN/NV/DRA.3
<b>International filing date</b> (day/month/year) 15 October 1999 (15.10.99)	<b>Priority date</b> (day/month/year) 16 October 1998 (16.10.98)
<b>Applicant</b> HUNT, Melvyn, John	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 31 March 2000 (31.03.00)

☐ in a notice effecting later election filed with the International Bureau on:  
 \_\_\_\_\_

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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 34, chemin des Colombettes  
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Pascal Piriou

Telephone No.: (41-22) 338.83.38

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NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

NEWELL, William, Joseph  
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ROYAUME-UNI

Date of mailing (day/month/year)

27 April 2000 (27.04.00)

Applicant's or agent's file reference

WN/NV/DRA.3

## IMPORTANT NOTICE

International application No.

PCT/GB99/03322

International filing date (day/month/year)

15 October 1999 (15.10.99)

Priority date (day/month/year)

16 October 1998 (16.10.98)

Applicant

DRAGON SYSTEMS UK RESEARCH &amp; DEVELOPMENT LIMITED et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:

AU,CN,JP,KP,KR,MA,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

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The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on

27 April 2000 (27.04.00) under No. WO 00/23984

## REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

## REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

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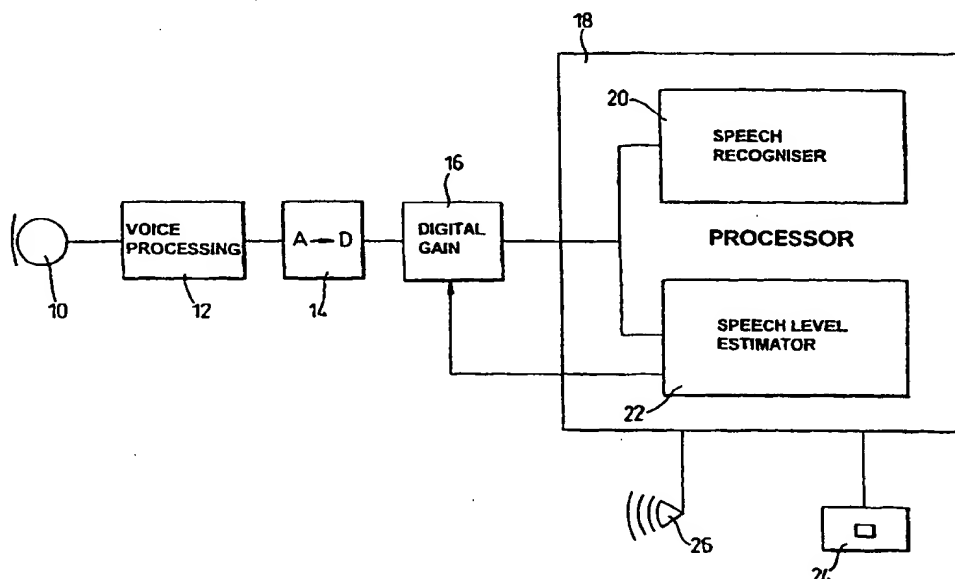
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : <b>G10L 15/20, 21/02</b>	<b>A1</b>	(11) International Publication Number: <b>WO 00/23984</b> (43) International Publication Date: 27 April 2000 (27.04.00)
<p>(21) International Application Number: PCT/GB99/03322</p> <p>(22) International Filing Date: 15 October 1999 (15.10.99)</p> <p>(30) Priority Data: 9822529.5 16 October 1998 (16.10.98) GB</p> <p>(71) Applicant (for all designated States except US): DRAGON SYSTEMS UK RESEARCH &amp; DEVELOPMENT LIMITED [GB/GB]; Millbank, Pullar Close, Stoke Road, Bishops Cleeve, Cheltenham, Gloucestershire GL52 4RW (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): HUNT, Melvyn, John [GB/GB]; 8 Dewey Close, Woodmancote, Cheltenham, Gloucestershire GL52 4UF (GB).</p> <p>(74) Agents: NEWELL, William, Joseph et al.; Wynne-Jones, Laine and James, 22 Rodney Road, Cheltenham, Gloucestershire GL50 1JJ (GB).</p>		<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> With international search report.</p>

(54) Title: SPEECH PROCESSING



## (57) Abstract

A speech recognition apparatus for use in an environment containing ambient acoustic noise includes a speech recogniser (20) for receiving and processing data representative of a speech utterance to be recognised to output data representative of or dependent on the lexical content of said utterance. The apparatus includes level adjusting means (16) for adjusting the level of the speech utterance. The apparatus also includes means for measuring said ambient acoustic noise level before or during said utterance, processing means (22) for using said measured acoustic noise level to predict the likely level of the speech utterance, and for adjusting the gain of the signal in accordance with said prediction of the likely level of the speech utterance.

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Speech Processing

This invention relates to apparatus and a method for estimating the speech level of a speaker exposed to an environment containing a variable amount of acoustic noise.

5 In particular, but not exclusively, the invention relates to such apparatus and methods for use in speech recognition.

The central process in automatic speech recognition is the comparison between some representation of the speech to  
10 be recognised and a set of reference models corresponding to speech sounds or words or other units. It is important that the level of the speech signal represented in the recogniser should be close to that expected by the models.

Because speech sounds vary in their intrinsic loudness,  
15 measuring overall speech level is not a trivial process. It is necessary either to take a large enough sample of the speech that the variations occurring between speech sounds average out, or to compare an utterance whose level is to be measured with an utterance at some known level whose  
20 phonetic content is the same. In this second method, phonetically identical speech sounds can be compared, but it does require a knowledge of the content of the utterance to be measured.

We have realised that it is in fact possible to  
25 estimate variations in the likely level of the speech signal in acoustically noisy environments by measuring the ambient noise level and using a phenomenon known as the Lombard

Effect to determine the likely speech levels. The Lombard Effect is the phenomenon that when people are exposed to noise their speech changes and becomes generally becomes louder. If no adjustment is made for the Lombard Effect in an automatic speech recognition system there will be a mismatch between the level of the speech to be recognised and the expected level. In principle, this could be corrected by observing the speech level and adjusting the gain of an amplifier in the recogniser to compensate for the variation in level. However, in some circumstances this is not a practical arrangement. For example, in a car the noise level can change from one utterance to another following changes in the speed of the car or in the road surface, or because a window is wound down. A gain setting based on the previous utterance will then be inappropriate. In some circumstances, it might be possible to wait until the utterance was complete, measure the speaking level, adjust the recorded utterance to normalise this level, and only then submit it to the recogniser. However, this process would introduce a delay in the response of the recogniser, which for many applications would be unacceptable.

In one aspect, this invention provides apparatus for predicting the speech level of a speaker exposed to an environment containing a variable level of ambient acoustic noise, the apparatus comprising means for measuring said ambient acoustic noise level, and processing means for using said measured acoustic noise level to predict the likely

speech level.

In this apparatus, as the noise level in the environment in which the speaker is located changes between utterances, so his speech level is likely to rise and fall  
5 in accordance with the Lombard Effect, and the apparatus predicts the likely speech level. We have found that the likely speech level can be predicted with reasonable accuracy by measuring the noise immediately adjacent to an utterance; measuring the level of a steady noise is quite  
10 simple and can be carried out with just a short sample of the noise. The apparatus preferably also uses a measure of the speech level and the corresponding noise level relating to a previous or standardised utterance.

The ambient acoustic noise level could be measured  
15 before, after or even during utterance of a word or phrase, and it is preferred for the measurement to be made close in time to the utterance to reduce the possibility of the prediction of the likely speech level being inaccurate due to a significant shift in noise level between measurement  
20 and the actual utterance.

It is preferred for the measuring means to measure the ambient acoustic noise level immediately before the utterance, the estimate of speech level being determined before or as the utterance is made rather than thereafter.  
25 Alternatively the measurement may be after the utterance.

The apparatus preferably includes means operable to define, for each utterance, an utterance period comprising a first time period for measuring said acoustic noise level

and a second time period during which said utterance is made.

Thus in a preferred embodiment, the apparatus includes a user input device (such as e.g. a switch) and a timer and  
5 control means for defining said first noise measuring period, and said second speech measuring and/or recording period, the end of said first period being indicated to said user.

In a particularly preferred aspect, said apparatus is  
10 responsive to a succession of one or more utterances by a speaker and said measuring means measures the ambient noise level prevailing at each of said utterances to provide a series of noise measurements and said apparatus includes means for measuring the speech level of an utterance, and  
15 said processing means uses at least two of said noise measurements, together with the measurement of the speech level of the immediately previous utterance, to produce the prediction of the speech level of the most recent utterance.

In one example, where the noise is measured immediately  
20 before an utterance, the processing apparatus means predicts the speech level  $S_1^*$  of an utterance (1) on the basis of the following expression:

$$S_1^* = S_0 + f(N_0 - N_1)$$

where  $S_0$  is the speech level of the immediately previous  
25 utterance;  $N_1, N_0$  are the noise levels prevailing immediately before the utterance whose speech level is to be estimated, and immediately before the next previous utterance respectively, and  $f(x)$  is a function relating changes in the



noise level in which the speaker is situated to the speaker's speech level.

The function is preferably monotonic increasing, and in a simple case is a multiplying factor less than 1. The multiplying factor may typically be a positive value in the range of from 0 to 0.6, and in one example is 0.32.

Alternatively the function may be a more complex function of the noise level difference. Likewise, the function may be modified to take account of more than just two noise level measurements; thus information relating to the speech levels of several previous utterances, together with the associated noise levels may be aggregated to predict the speech level of the next utterance.

In another aspect, this invention provides speech recognition or processing apparatus including predicting apparatus as set out above for use in adjusting the gain of the speech signal prior to recognition processing.

In yet another aspect, this invention provides a method for predicting the speech level of a speaker exposed to an environment containing a variable level of ambient acoustic noise, said method comprising the steps of:-

measuring said ambient acoustic noise level, and processing said measured acoustic noise level to produce a prediction of the likely speech level.

In a further aspect, this invention provides a method for controlling the gain in a speech recognition or processing system, which comprises controlling the gain of the speech signal in accordance with a prediction of the

speech level obtained by the above method.

Whilst the invention has been described above, it extends to any inventive combination of the features set out above or in the following descriptions.

5       The invention may be performed in various ways, and an embodiment thereof will now be described by way of example only, reference being made to the accompanying drawing in which:-

Figure 1 is a block diagram of a speech recogniser  
10       incorporating speech level prediction in accordance with the invention.

The illustrated embodiment implements a system which applies knowledge of variation in the ambient acoustic noise level and its likely effect on the speech level to predict  
15       the speech level in the next utterance to be recognised by a speech recogniser. It is assumed that the variation in noise level over the duration of a single utterance is small compared with the variations occurring between utterances, and also that the noise has sufficient short-term  
20       stationarity that its level can be measured from a brief sample.

Referring to Figure 1, the speech recognition system comprises a microphone 10 whose output is subjected to voice processing at 12 before analogue to digital conversion at  
25       14. The digital signal passes via a digital gain device 16 to a processor 18 which incorporates a recogniser 20 and a speech level estimator 22. The speech recogniser may be of any suitable type and examples of suitable recognisers will

be well known to those skilled in the art. The processor 18 also receives an input from a switch 24 acting as a user input device, and can issue warning tones to the user through a sounder 26.

5       The system illustrated is intended for use in a noisy environment whose noise level varies. In use, the user alerts the system when he wants to make an utterance to be recognised, by closing the switch 24. The processor then defines an utterance frame, comprising a first short time  
10   period, during which the ambient noise is sampled, followed by issuing a tone on the sounder 26, which indicates to the user that he may speak, followed by a second period during which the speech signal is sampled and sent to the recogniser 20. The second period is longer than the first  
15   period and sufficiently long to contain the longest utterance to be recognised. There are a number of ways of delimiting the second period other than providing a period of set duration. For example the length of the period may be user designated, e.g. by the user keeping the button  
20   pressed or pressing the button again. Alternatively, the processor may listen for a period of silence, or it may infer the end of a command based on an analysis of the grammar of the utterance. In addition, instead of using a switch, the start of the utterance frame may be marked by  
25   the user uttering a codeword.

Since it is known that speech levels vary with noise level, it is possible to predict a change in the speech level in an utterance from a change in the noise level. The

speech and noise levels,  $S_0$  and  $N_0$ , (in dB units) are measured by the processor in one noise condition. The new noise level,  $N_1$ , in the first period of the next utterance, just before the start of an utterance to be recognised, is also  
5 measured by the processor. The difference in the two noise levels,  $N_0 - N_1$ , is then determined and used by the processor, together with knowledge of the speech level,  $S_0$ , of the previous utterance, to predict the speech level,  $S_1$ , of the new utterance. We can write  $S_1^* = S_0 + f(N_0 - N_1)$ , where  $S_1^*$  is  
10 a prediction estimate of  $S_1$  and  $f(x)$  is the function relating changes in the noise level in the speaker's ears to the speaker's speech level. In the simplest arrangement, the function is a multiplying factor less than 1, but it can also be a more complex function of the noise level  
15 difference. In practice we have determined empirically that the speech level good results are achieved in one application by using a multiplying factor of typically 0.3 although positive values between 0 and 0.6 should all provide some improvement. It may be assumed to be the same  
20 for all speakers or may be estimated separately for each speaker.

Since the measurements of the reference speech and noise levels,  $S_0$  and  $N_0$ , respectively, are subject to measurement errors, it may be preferred to aggregate the  
25 information contributing to the prediction of  $S_1$  from several previous utterances and noise estimates. The computation of  $S_1^*$  described in the previous paragraph can be replaced by an average over several previous utterances. This may be a

simple average or it may be a weighted average, the weights possibly depending on factors such as the time difference between the various reference utterances and  $S_1$  and on the relative durations of the various reference utterances. For example the computation may take account of any time effects. For example it may be found that, when exposed to a particular level of ambient noise that the speaker's speech level rises over an initial period and then decreases, in a temporal filtering effect.

Having determined an estimate of the speech level of the new utterance, the processor controls the gain of the signal accordingly. The gain may be adjusted at various points; it may be adjusted whilst the signal is still in the analogue domain or it may be achieved by digital scaling as shown by the digital gain device 16. A further alternative is to manipulate the fast fourier transform (FFT) values in the speech recogniser. If a cepstrum is computed, the signal may be scaled by adding an appropriate constant to the  $C_0$  coefficient. In a further arrangement, the system may compensate for increases or decreases in the speech level by adjusting the effective speech levels that the models in the recogniser represent.

The gain may take into account factors other than simply the level of the background noise; for example it could also take account of its spectral structure.

The output of the recogniser may be used in any convenient form. For example it could be used to enable a person to issue spoken commands to equipment.

Claims

1. Apparatus for predicting the speech level in an utterance of a speaker exposed to an environment containing a variable level of ambient acoustic noise, the apparatus  
5 comprising means for measuring said ambient acoustic noise level, and processing means for using said measured acoustic noise level to predict the likely speech level in said utterance.
2. Apparatus according to Claim 1, wherein said measuring  
10 means measures the ambient acoustic noise level immediately adjacent to said utterance.
3. Apparatus according to Claim 2, including means for activating said measuring means before the utterance.
4. Apparatus according to an preceding Claim which  
15 includes means operable to define, for each utterance, an utterance period comprising a first time period for measuring said acoustic noise level and a second time period during which said utterance is made.
5. Apparatus according to Claim 4, which includes a user  
20 input device, a timer, control means for defining said first period, and said second period, and means for indicating to a user the end of said first period.
6. Apparatus according to Claim 5, wherein said apparatus  
25 is responsive to a succession of one or more utterances by a speaker, and said measuring means is operable to measure the ambient noise level prevailing at each of said utterances to provide a series of noise values, and said

apparatus includes means for measuring the speech level of an utterance, and said processing means uses at least two of said noise values, together with a value representative of the speech level of the immediately previous utterance, to  
5 predict the likely speech level of the next utterance.

7. Apparatus according to Claim 6, wherein said measuring means is adapted to measure the ambient acoustic noise level before an utterance, and the processing means estimates the speech level  $S_1^*$  of an utterance (1) on the basis of the  
10 following expression:

$$S_1^* = S_0 + f(N_0 - N_1)$$

where

$S_0$  is the speech level of the immediately previous utterance;

15  $N_1, N_0$  are the noise levels prevailing immediately before the utterance whose speech level is to be estimated, and immediately before the next previous utterance respectively, and

$f(x)$  is a function relating changes in the noise level  
20 in which the speaker is situated to the speaker's speech level.

8. Apparatus according to Claim 7, wherein said processing means predicts the speech level  $S_1^*$  on the basis of the following expression:

25  $S_1^* = S_0 + k(N_0 - N_1)$

where  $k$  is a constant,  $k > 1$ .

9. Apparatus according to Claim 8, wherein  $k$  lies in the range of from 0 to 0.6.

10. A speech recognition apparatus for use in an environment containing ambient acoustic noise, said apparatus including speech recogniser means for receiving and processing data representative of a speech utterance to  
5 be recognised to output data representative of or dependent on the lexical content of said utterance, said apparatus including level adjusting means for adjusting the level of the speech utterance, said apparatus further including means for measuring said ambient acoustic noise level before or  
10 during said utterance, processing means for using said measured acoustic noise level to predict the likely level of the speech utterance, and means for adjusting said level controlling means in accordance with said prediction of the likely level of the speech utterance.

15 11. A method for predicting the speech level of an utterance of a speaker exposed to an environment containing a variable level of ambient acoustic noise, said method comprising the steps of:-

measuring said ambient acoustic noise level, and  
20 processing said measured acoustic noise level to predict the likely speech level of said utterance.

12 A method according to Claim 11, wherein said ambient acoustic noise level is measured before said utterance.

13. A method according to Claim 11, wherein a plurality of  
25 measurements of said acoustic noise level is taken and used with one or measurements of the speech levels corresponding to said measurements of acoustic noise level to predict the likely speech level of the utterance.

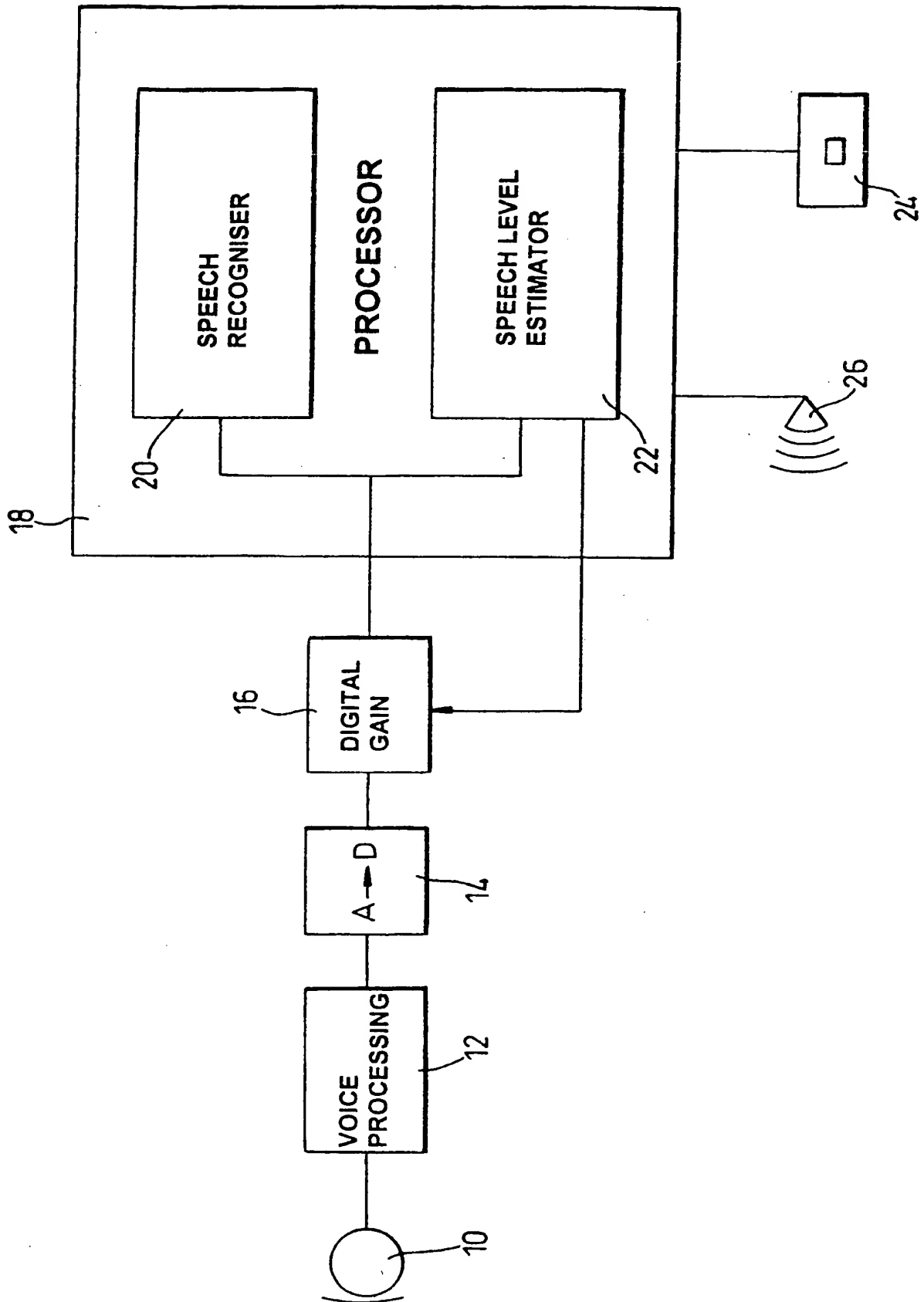


14. A method for controlling the gain in a speech recognition or processing system in an environment containing a variable level of ambient acoustic noise, which method comprises controlling the gain of the speech signal  
5 in accordance with an estimate of the speech level, said estimate being obtained by measuring said ambient acoustic noise level, and processing said measured acoustic noise level to produce an estimate of the likely speech level of said utterance.

**ABSTRACT**

A speech recognition apparatus for use in an environment containing ambient acoustic noise includes a speech recognizer (20) for receiving and processing data representative of a speech utterance to be recognized to output data representative of or dependent on the lexical content of the utterance. The apparatus includes level adjusting elements (16) for adjusting the level of the speech utterance. The apparatus also includes elements for measuring the said ambient acoustic noise level before or during the utterance, processing elements (22) for using the measured acoustic noise level to predict the likely level of the speech utterance, and for adjusting the gain of the signal in accordance with the prediction of the likely level of the speech utterance.

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## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB 99/03322

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G10L15/20 G10L21/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 361 324 A (TAKIZAWA YUMI ET AL) 1 November 1994 (1994-11-01) column 1, line 16 - line 28 column 10, line 57 - line 59 claim 7	1-3, 10-12, 14
Y	EP 0 248 609 A (BRITISH TELECOMM) 9 December 1987 (1987-12-09) page 2, column 1, line 9 - line 18 page 3, column 3, line 11 - column 4, line 15; figure 1	1-3, 10-12, 14
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 197 (P-1523), 16 April 1993 (1993-04-16) & JP 04 343399 A (RICOH CO LTD), 30 November 1992 (1992-11-30) abstract	1, 10, 11, 14

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

25 January 2000

Date of mailing of the international search report

01/02/2000

Name and mailing address of the ISA

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Authorized officer

Wanzeele, R

## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 99/03322

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 673 (P-1658), 10 December 1993 (1993-12-10) & JP 05 224694 A (RICOH CO LTD), 3 September 1993 (1993-09-03) abstract ---	1, 10, 11, 14
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 244 (P-1734), 10 May 1994 (1994-05-10) & JP 06 027991 A (TOSHIBA CORP; OTHERS: 01), 4 February 1994 (1994-02-04) abstract ---	1, 10, 11, 14
A	EP 0 093 303 A (NISSAN MOTOR) 9 November 1983 (1983-11-09) claim 1 ---	1, 10, 11, 14
A	DE 197 51 536 A (SAMSUNG ELECTRONICS CO LTD) 27 August 1998 (1998-08-27) claim 4 -----	1, 10, 11, 14

# INTERNATIONAL SEARCH REPORT

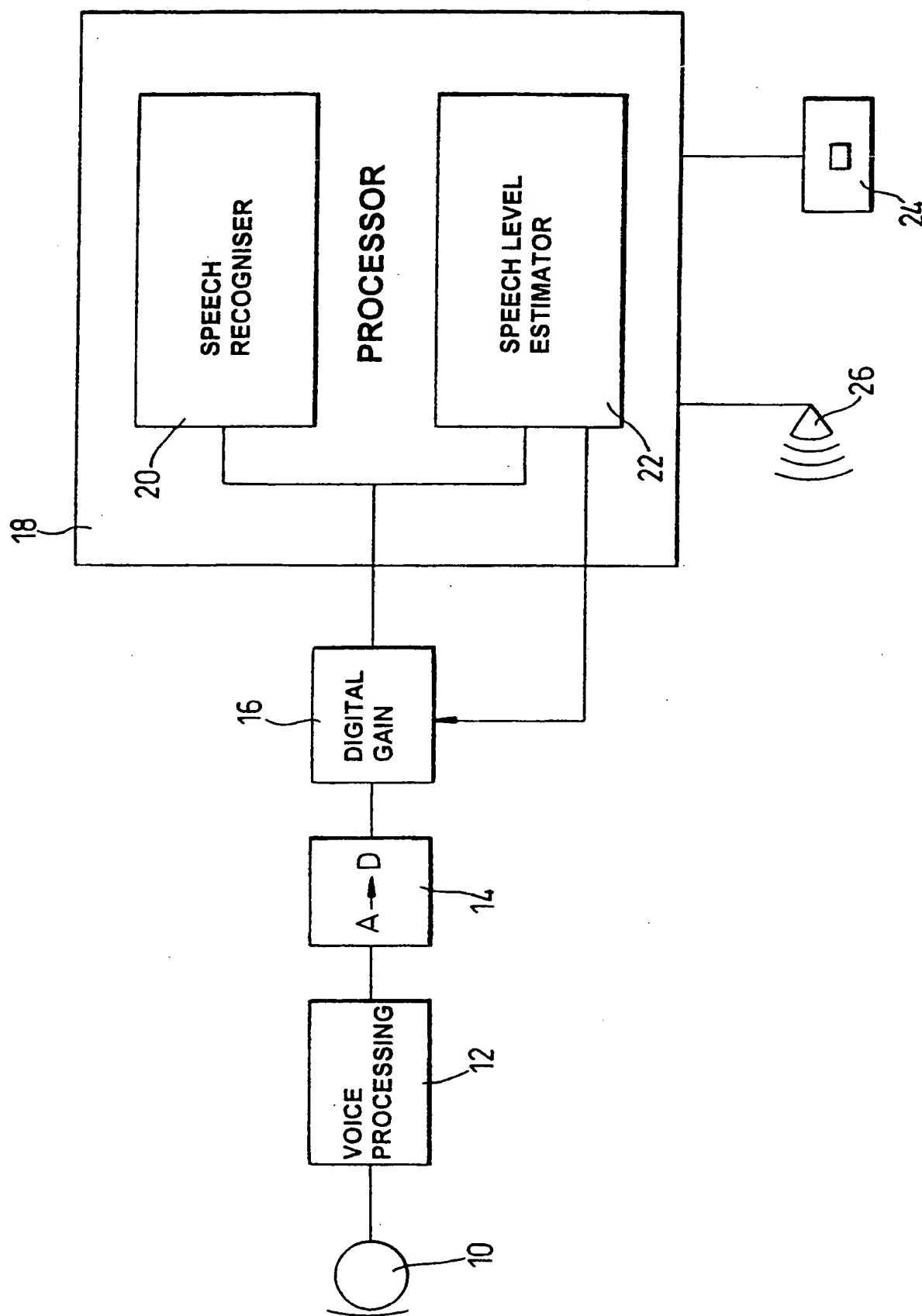
Information on patent family members

International Application No

PCT/GB 99/03322

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5361324 A	01-11-1994	DE 69033000 D	22-04-1999
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		JP 2969862 B	02-11-1999
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		CA 1310418 A	17-11-1992
		DE 3750314 D	08-09-1994
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		DE 3752288 D	09-09-1999
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		FI 872450 A,B,	03-12-1987
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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference WN/NV/DRA.3	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03322	International filing date (day/month/year) 15/10/1999	Priority date (day/month/year) 16/10/1998
International Patent Classification (IPC) or national classification and IPC G10L15/20		
Applicant DRAGON SYSTEMS UK RESEARCH & DEVELOPMENT...et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 31/03/2000	Date of completion of this report 02.01.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer De Vos, L Telephone No. +49 89 2399 2048 



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03322

## I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

### Description, pages:

1-9 as originally filed

### Claims, No.:

1-14 as originally filed

### Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB99/03322

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	6-9, 13
	No:	Claims	1-5, 10-12, 14
Inventive step (IS)	Yes:	Claims	6-9, 13
	No:	Claims	1-5, 10-12, 14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**V. Reasoned statement under Art. 35(2) PCT**

1. Present independent apparatus claim 1 is not fulfilling the requirements under the PCT for lack of novelty (Art. 33(2) PCT).

The examiner introduces Document US-A-4696041, denoted in this communication as D8.

Document D8 (see in particular the abstract, l. 7-15) discloses (applying the terminology of present independent claim 1) an:

"apparatus for predicting the speech level (see Title of D8) in an utterance of a speaker exposed to an environment containing a variable level of ambient acoustic noise (D8, col. 1, l. 26-28), the apparatus comprising

means for measuring said ambient acoustic noise level (D8, abstract, l. 7-10), and

processing means for using said measured acoustic noise level to predict the likely speech level in said utterance (D8, abstract, l. 11-14)."

This is exactly the wording of present claim 1, which is therefore not novel and fails to fulfill the requirements of Art. 33(2) PCT.

For the sake of completeness, it is mentioned that also International Search Report Document D6 ( EP-A-093303) implicitly takes away novelty of present independent claim 1. Indeed, D6 mentions the " means for measuring said ambient acoustic noise level" (D6, p. 4, l. 15-16) and a gain controller in inverse proportion to the background noise controller (p. 4, l. 18-21). In the examiner's opinion this gain controller implicitly discloses that knowledge about the speech level to be expected is deduced from the measured noise level. For this reason present claim 1 is also not novel over D6.

Nevertheless document D8 has been preferred, since it explicitly discloses the features of claim 1.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB99/03322

2. Present independent method claim 11 is corresponding to present independent apparatus claim 1, and therefore fails to fulfill the requirements under the PCT for the same reason as explained above for claim 1 (lack of novelty, Art. 33(2) PCT).
3. Present claims 2-5 are not novel over D6, and are hence not fulfilling the requirements of Art 33(2) PCT.

The applicant is referred to D6, p. 14, l. 17 - p. 16, l. 12, as well as to Figs. 2 and 3(A)-(G). See the indicated time period T0, being immediately adjacent to the utterance (claim 2), the "recognition switch sig" in Fig. 3(A) (claim 3), the time schedule in Fig. 3, particularly the buzzer signal (claims 4 and 5).

Therefore all features of claims 2-5 are explicitly or implicitly (see above) disclosed in D6. Consequently, claims 2-5 are unacceptable for lack of novelty (Art. 33(2) PCT).

4. Present dependent method claim 12 is corresponding to present dependent apparatus claim 3, and therefore equally fails to be novel over D6 (Art.33(2) PCT).
5. No objections under the PCT are formulated against present claim 6, nor against present claim 13.

As a matter of fact, none of the International Search Report Documents, nor Document D8, disclose or make obvious the use of previous speech level measurements while predicting the likely speech level of an utterance.

The features of present apparatus claims 6 and 1 and, correspondingly, of present method claims 13 and 11, should therefore have been combined to formulate new, allowable independent apparatus and method claims, respectively.

6. No objections under the PCT are formulated against claim 7, nor would any objections under the PCT have been formulated against claims 8-9 either, provided that claim 8 had been corrected as indicated below.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB99/03322

7. Present independent apparatus claim 10 (see also the clarity objection in Sec. 12) and present independent method claim 14 fail to fulfill the requirements under the PCT for lack of novelty (Art. 33(2) PCT). As a matter of fact, these claims claim as only feature over claims 1 and 11, respectively, the fact that the gain of a speech signal is controlled in accordance with the estimate of a speech level. This feature has already been shown above to be disclosed in D6 (see Section 2 of this communication).

Consequently, present independent claims 10 and 14 are unacceptable for lack of novelty (Art. 33(2) PCT).

**VII. Certain defects in the international application**

8. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
9. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D6 and D8 is not mentioned in the description, nor are these documents identified therein.

It is noted that D6 is considered to be the closest prior art for the subject matter presently dealt with in claims 2-5, 10-12 and 14, whereas D8 is to be considered as the closest prior art for the subject matter presently dealt with in claims 6-9 and 13.

**VIII. Certain observations on the international application**

10. The vague and imprecise statement in the description on page 6, l. 3-4 ("extends to any inventive combination of the features set out above or in the following descriptions") implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB99/03322

In order to overcome this objection, the above-cited wording should have been reformulated along the lines of "extends to the combination of the features as set out in the appended claims".

11. Present independent claim 10 fails to fulfill the requirements under the PCT, since this claim is not clear (Art. 6 PCT).

As a matter of fact, this claim mentions "said level controlling means" on l. 12-13, although no level controlling means have been mentioned earlier in the claim.

In order to be able to yet examine this claim, the examiner has assumed that "said level controlling means" would have been replaced by "said level".

12. It is noted that present independent claim 10 actually contains all features of present independent claim 1 and should therefore have been formulated as a dependent claim referring to present independent claim 1 (R. 6.4.(a) PCT). See in this context the description, p. 5, l. 14-17.

Similarly, present independent claim 14 actually contains all features of present independent claim 11 and should therefore have been formulated as a dependent claim referring to present independent claim 11 (R. 6.4.(a) PCT). See in this context the description, p. 5, l. 25 - p. 6, l. 1.

For reformulation of claims 10 and 14, however, see Sec. 7 of this communication, stating lack of novelty (Art. 33(2) PCT)..

13. Taking into account that the function  $f(x)$  is intended to be e.g. a multiplying factor less than 1 (and, presumably, larger than 0), see the description, p. 8, l. 13 and l. 17-18, it appears that in the formula on p. 8, l. 9, " $f(N_0-N_1)$ " should actually have read " $f(N_1-N_0)$ ". This error should have been corrected.

Similarly, in present claim 8, " $k(N_0-N_1)$ " should actually have read " $k(N_1-N_0)$ ".

Furthermore, also in claim 8, " $k>1$ " should apparently have read " $k<1$ ".

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>WN/NV/DRA.3</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 99/ 03322</b>	International filing date (day/month/year) <b>15/10/1999</b>	(Earliest) Priority Date (day/month/year) <b>16/10/1998</b>
Applicant <b>DRAGON SYSTEMS UK RESEARCH &amp; DEVELOPMENT...et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

**SPEECH PROCESING**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1

☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/03322

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G10L15/20 G10L21/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 361 324 A (TAKIZAWA YUMI ET AL) 1 November 1994 (1994-11-01) column 1, line 16 - line 28 column 10, line 57 - line 59 claim 7 ---	1-3, 10-12, 14
Y	EP 0 248 609 A (BRITISH TELECOMM) 9 December 1987 (1987-12-09) page 2, column 1, line 9 - line 18 page 3, column 3, line 11 - column 4, line 15; figure 1 ---	1-3, 10-12, 14
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 197 (P-1523), 16 April 1993 (1993-04-16) & JP 04 343399 A (RICOH CO LTD), 30 November 1992 (1992-11-30) abstract --- -/--	1, 10, 11, 14



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

25 January 2000

Date of mailing of the international search report

01/02/2000

Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 99/03322

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category <sup>2</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 673 (P-1658), 10 December 1993 (1993-12-10) & JP 05 224694 A (RICOH CO LTD), 3 September 1993 (1993-09-03) abstract ---	1, 10, 11, 14
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 244 (P-1734), 10 May 1994 (1994-05-10) & JP 06 027991 A (TOSHIBA CORP; OTHERS: 01), 4 February 1994 (1994-02-04) abstract ---	1, 10, 11, 14
A	EP 0 093 303 A (NISSAN MOTOR) 9 November 1983 (1983-11-09) claim 1 ---	1, 10, 11, 14
A	DE 197 51 536 A (SAMSUNG ELECTRONICS CO LTD) 27 August 1998 (1998-08-27) claim 4 -----	1, 10, 11, 14

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03322

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5361324	A	01-11-1994	DE 69033000 D	22-04-1999
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			EP 0421341 A	10-04-1991
			JP 2969862 B	02-11-1999
			JP 3206499 A	09-09-1991
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EP 0248609	A	09-12-1987	AT 109582 T	15-08-1994
			AT 143009 T	15-08-1999
			CA 1310418 A	17-11-1992
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			EP 0750291 A	27-12-1996
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JP 04343399	A	30-11-1992	NONE	
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JP 05224694	A	03-09-1993	NONE	
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JP 06027991	A	04-02-1994	NONE	
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EP 0093303	A	09-11-1983	JP 58190994 A	08-11-1983
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